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Determination of an Effective Single Lethal Dose for Bromadiolone to Columbian Ground Squirrels

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by
Daniel Sullivan

ABSTRACT

A single dose feeding of bromadiolone treated hulled oats resulted in death to 26 of 30 Columbian Ground Squirrels (Spermophilus columbianus) tested. No animals survived an oral dose of bromadiolone greater than 2.10 mg/kg. Results indicate bromadiolone has the potential to be effective in single doses for control of Columbian Ground Squirrels.

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INTRODUCTION

Presently there is a lack of effective alternatives to traditional single dose field rodenticides such as strychnine, 1080 and zinc phosphide. Each of these traditional compounds has environmental, efficacy and/or economic disadvantages. These compounds have uncertain futures regarding registration as rodenticides.

The use of strychnine treated grain baits for control of the Columbian Ground Squirrel (Spermophilus columbianus) has traditionally obtained poor results (Albert and Record, 1979, Record, 1978 and 1976; Sullivan and Baril, 1981). Restrictions are currently under consideration by the Environmental Protection Agency and the State of Montana on the use of strychnine because of hazards to nontarget species. If inacted these restrictions will prohibit or make impractical the use of strychnine for rodent control in many circumstances. Sodium monofluoroacetate (1080) grain baits have been used in Montana in 1979, 1981 and 1982 under a specific exemption (FIFRA, Section 18). Compound 1080 has given excellent control of Columbians (Albert and Record, 1979; Lingel-Pate, 1981). Future registration for 1080, either temporary or long term, is uncertain. The use of 1080 has been controversial because of the hazard to nontarget species and questions regarding 1080's humaneness. Zinc phosphide has given effective control of Columbian ground squirrels (Sullivan and Baril, 1981) but does have problems. It requires prebaiting, possesses high potential for nontarget deaths and has shown to be erratic in control (Baril, 1980; Albert and Record, 1979). Zinc phosphide is not currently registered for Columbian Ground Squirrels. Currently registered anticoagulants require repeat feeding from bait stations to obtain a lethal dose. Except for high value lands or crops repeat applications or use of bait stations may not be economically practical for most field rodent control. For these reasons it seems prudent to evaluate and develop alternative rodenticides.

Suitable alternatives should be relatively selective to the target animals, either biologically or through selective formulation of the carrier. Suitable alternatives should be single dose, have a high degree of effectiveness and be economically feasible.

Bromadiolone is an anticoagulant rodenticide that has been shown effective for control of commensal rodents (Marsh, et. al., 1980; Meehan, 1978; Redfern and Gill, 1980). It has received federal registration for commensal rodent control (Lipha Chem. Co.; Bell Laboratories). Recent studies have shown potential for control of ground squirrels (Baker, 1980; Marsh, 1977). LD_{50} studies on rats and mice (1.125 mg/kg - rats; 1.75 mg/kg - mice [Anon., undated]) indicate bromadiolone may be effective as a single dose rodenticide for the Columbian Ground Squirrel.

Bromadiolone has been shown to have a relatively low risk from secondary poisoning (Mendenhall and Pank, 1980; Anon., undated). Should bromadiolone prove to be effective as a single dose rodenticide it may be an economical alternative to the traditional acute rodenticides.

OBJECTIVE

To determine an effective single lethal dose for bromadiolone to Columbian Ground Squirrels.

METHODS

Procedures for determining an effective single lethal dose were modeled after recommendations by R.E. Marsh (pers. com.).

Thirty adult Columbian Ground Squirrels were trapped during June, 1982, from the Helena valley, Lewis and Clark County, Montana. Squirrels were captured in livetraps (6X6X19 in., Tomahawk No. 202) bait with molasses flavored rolled barley. Squirrels were placed individually in 9X12X12 inch cages. Water and food (whole oats) were provided ad libitum. Squirrels were allowed to acclimate to the caged environment for at least 1 week prior to testing.

The squirrels were assigned to 5 groups of 6 animals each, 3 males and 3 females. Squirrels were distributed among the groups on the basis of size to reduce variations because of weight. All animals were eating regularly and appeared healthy prior to testing.

Each group of squirrels was fed one of the following doses of bromadiolone on whole hulled oats: 0.25, 0.50, 0.75, 1.00, and 1.50 mg active ingredient. The untreated whole oats were removed and the cages cleaned prior to placing the bromadiolone bait in the feeding trays. The bromadiolone bait was left in the trays until consumed by the squirrels. Any bait dropped through the cage floor was collected and weighed.

Test baits were provided by personnel of the Chempar Products Division of Lipha Chemical Company. The quantity of bait received by the squirrels in each test group was 5 grams (0.25 mg and 0.75 mg AI) or 10 grams (0.50 mg, 1.00 mg and 1.50 mg AI) depending on the bromadiolone concentration on the test baits.

Squirrels were weighed to the nearest 0.1 gram using a triple beam balance prior to dosing. Weight of each squirrel was taken at death.

Squirrels were observed for 35 days after dosing. All squirrels alive at the end to the test period were killed using CO_2 gas.

RESULTS AND DISCUSSION

Tables 1 and 2 show that squirrel mortality occurred at each dose level administered. Although mortality occurred as low as 0.36 mg/kg in this study, development of a practical single dose bait requires that all ground squirrels consuming the bait receive a lethal dose of the toxicant. The lowest dose above which survival did not occur was 2.10 mg/kg (Table 1). Considering the small sample size used in this study, variations in ground squirrels and their environment and variables introduced during practical applications of rodent control programs the minimum dose for all squirrels should be no less than 2.10 mg/kg. To allow for the possibility that some animals may survive a 2.10 mg/kg dose increasing the dose up to 25% for field trails is recommended (R.E. Marsh, pers. com.).

CONCLUSIONS

Single dose feedings of bromadiolone treated bait to captive Columbian Ground Squirrels ranging from 0.36 to 3.78 mg/kg resulted in death to 26 of 30 squirrels tested. No squirrel survived doses greater than 2.10 mg/kg. These results indicate bromadiolone treated baits may be an effective single dose field rodenticide. Evaluations need to be conducted to determine bromadiolone's effectiveness under field situations.

Table 1. Death (D) and Survival (S) of Columbian Ground Squirrels 35 days after receiving a single dose of bromadiolone on whole hulled oats.

Animal No.	Dose AI (mg)	AI Intake (mg/kg)	Results
1-25	0.25	0.36	D
4-25	0.25	0.41	D
2-25	0.25	0.46	D
5-25	0.25	0.47	D
6-25	0.25	0.49	S
3-25	0.25	0.52	D
1-50	0.50	0.77	D
2-50	0.50	0.92	D
4-50	0.50	0.92	D
5-50	0.50	0.97	D
6-50	0.50	1.13	D
1-75	0.75	1.13	S
3-50	0.50	1.20	D
2-75	0.75	1.31	D
4-75	0.75	1.33	D
5-75	0.75	1.36	D
1-100	1.00	1.49	D
4-100	1.00	1.59	D
3-75	0.75	1.76	D
2-100	0.75	1.87	S
5-100	1.00	1.89	D
6-100	1.00	1.89	D
6-75	0.75	2.02	S
3-100	1.00	2.10	D
1-150	1.50	2.20	D
4-150	1.50	2.78	D
2-150	1.50	2.87	D
5-150	1.50	2.97	D
6-150	1.50	3.28	D
3-150	1.50	3.78	D

Table 2. Average intake per kilogram of body weight, mortality and weight change of Columbian Ground Squirrels following a single oral dose of bromadiolone on hulled oats.

Dose			Days to Death*		
mg/squirrel	Ave. intake (mg) per kg (Range)	Mortality	Mean	Range	Weight Change
0.25	0.45 (0.36-0.52)	5/6	9.2	5-24	- 7.8%
0.50	0.97 (0.77-1.20)	6/6	6.3	5-8	- 4.0%
0.75	1.48 (1.13-2.02)	4/6	10.5	5-18	-14.7%
1.00	1.81 (1.49-2.10)	5/6	11.4	7-19	-15.3%
1.50	2.98 (2.20-3.78)	6/6	10.0	7-18	-10.2%

*Calculations include only those squirrels that died during the test.

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